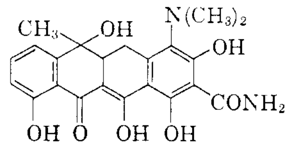
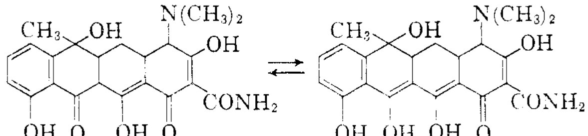


III

$C_{22}H_{22}N_2O_7$: C, 61.83; H, 5.29; N, 6.50]. Mild acid degradation converts III, *via* 5a,6-*trans* elimination of water, to terrarubein,[7] the only common tetracycline-oxytetracycline degradation product reported to date.

Catalytic hydrogenation [Pd/C in tetrahydrofuran] of O[12a]-formyltetracycline yields 12a-deoxytetracycline (IV), a compound which Green and



IV

Booth have prepared independently *via* a zinc in ammonium hydroxide reduction of tetracycline.[2,3] Compound IV retains appreciable antimicrobial activity.[6] Reoxidation of IV to tetracycline has been reported.[2] Acid degradation converts IV to *5a,6-anhydro-12a-deoxytetracycline* [ultraviolet spectrum[5]: λ_{max} 272, 325, 378 and 434 mμ, log ϵ 4.52, 3.95, 4.12 and 4.34. *Anal.* Found for $C_{22}H_{22}N_2O_6 \cdot HCl$: C, 59.5; H, 5.37; N, 6.14].

Transformations similar to those described above also have been carried out on other members of the tetracycline series.

(7) F. A. Hochstein, C. R. Stephens, L. H. Conover, P. P. Regna, R. Pasternack, P. N. Gordon, F. J. Pilgrim, K. J. Brunings and R. B. Woodward, THIS JOURNAL, **75**, 5455 (1953).

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HYDROBORATION AS A CONVENIENT SYNTHETIC ROUTE TO THE ALIPHATIC BORONIC AND BORINIC ACIDS AND ESTERS

Sir:

The aliphatic boronic acids are generally synthesized by the reaction of the Grignard reagent with methyl borate at $-70°$.[1] The related borinic acids have been obtained from trialkylboranes by hydrolysis of the initial oxidation product[2] or by hydrolysis of the dialkylboron halide[3] also derived from the trialkylborane.[3,4] The discovery that olefins rapidly undergo hydroboration to form the corresponding organoboranes in essentially quantitative yield[5] led us to explore synthetic routes to the aliphatic boronic and borinic acids based on the hydroboration reaction.

(1) H. R. Snyder, J. A. Kuck and J. R. Johnson, THIS JOURNAL, **60**, 105 (1938).

(2) J. R. Johnson and M. G. Van Campen, Jr., *ibid.*, **60**, 121 (1938).

(3) J. R. Johnson, H. R. Snyder and M. G. Van Campen, Jr., *ibid.*, **60**, 115 (1938).

(4) P. A. McCusker, G. F. Hennion and E. C. Ashby, *ibid.*, **79**, 5192 (1957).

(5) H. C. Brown and B. C. Subba Rao, *ibid.*, **78**, 5694 (1956); H. C. Brown and B. C. Subba Rao, *J. Org. Chem.*, **22**, 1137 (1957); H. C. Brown and G. Zweifel, THIS JOURNAL, **81**, 4106 (1959).

Cyclopentene, 0.300 mole, was added over 1 hr. to a solution of 0.150 mole of diborane in 350 ml. of tetrahydrofuran at 0°. After a second hour at 0°, 100 ml. of methanol was added and the mixture was distilled. There was obtained 17.4 g. (65% yield) of methyl dicyclopentaneborinate, b.p. 121–122° at 21 mm., $n^{20}D$ 1.4717.

Anal. Calcd. for $C_{11}H_{21}BO$: C, 73.35; H, 11.75; B, 6.01. Found: C, 73.01; H, 11.55; B, 6.00.

Similarly, 1-pentene was converted into methyl di-1-pentaneborinate, 16.3 g. (60% yield), b.p. 101–104 at 20 mm., $n^{20}D$ 1.4238.

Anal. Calcd. for $C_{11}H_{25}BO$: C, 71.75; H, 13.69; B, 5.88. Found: C, 71.54; H, 13.64; B, 5.87.

Addition of 0.150 mole of diborane to 0.300 mole of the olefin in tetrahydrofuran results in the predominant formation of the trialkylborane. However, redistribution[6] occurs at 25–50° to form the monoalkylborane in reasonable yield.

Diborane, 0.150 mole, was passed into a solution of 20.4 g., 0.300 mole, of cyclopentene in 200 ml. of tetrahydrofuran at 0°. The reaction mixture then was maintained at 50° for 24 hr. To the cooled reaction mixture 100 ml. of methanol was added and the reaction mixture was distilled. There was obtained 25.4 g. (60% yield) of dimethyl cyclopentaneboronate, b.p. 60–62° at 20 mm., $n^{20}D$ 1.4300.

Similarly, 1-pentene was converted into dimethyl 1-pentaneboronate, 19.1 g., (44% yield), b.p. 55–57° at 20 mm., $n^{20}D$ 1.4025.

Anal. Calcd. for $C_7H_{17}BO_2$: C, 58.37; H, 11.90; B, 7.51. Found: C, 58.34; H, 11.80; B, 7.50.

Treatment of the 1-butane- and 1-hexaneboronic acids with ammoniacal silver nitrate converts them into *n*-octane and *n*-dodecane in excellent yield.[1] Consequently, the conversion of unsaturated compounds into the corresponding boronic acid and then treatment with ammonical silver nitrate should provide a useful dimerization procedure for alkenes and certain of their functional derivatives: $2RCH{=}CH_2 \rightarrow (RCH_2CH_2)_2$. We are exploring the full scope and utility of this synthesis.

(6) H. I. Schlesinger and A. O. Walker, *ibid.*, **57**, 621 (1935).

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RECEIVED DECEMBER 31, 1959

Δ^4-3-KETO STEROIDAL ENOL ETHERS. PARADOXICAL DEPENDENCY OF THEIR EFFECTIVENESS ON THE ADMINISTRATION ROUTE

Sir:

We have found that through enol etherification with suitable alcohols the hormonal activity of Δ^4-3-keto steroids can be lessened by parenteral and enhanced by oral use. Of the many enol ethers we have assayed,[1] several were undescribed:

(1) Biological and cancer chemotherapy tests performed in our laboratories with the collaboration of G. Bruni, F. Galletti, G. Falconi and A. Meli. The compounds were mostly administered in oily solution both by parenteral and oral route. The absence of parent ketones